

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Panayotis C. Andricacos et al.

Conf. No.: 3511

Application No.: 10/615,794

Group Art Unit: 1795

Filed: July 10, 2003

Examiner: N.A. Smith

For: A VOID-FREE DAMASCENE COPPER
DEPOSITION PROCESS AND MEANS OF
MONITORING THEREOF

RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPEAL BRIEF

MS Appeals Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notification of Non-Compliant Appeal Brief – Filing Date Granted mailed October 31, 2007, Applicant respectfully submit herewith a Supplemental Appeal Brief with regard to the above-identified application.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0510, under Order No. YOR920030059US1.

Dated: November 19, 2007

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Panayotis C. Andricacos et al.

Application No.: 10/615,794

Confirmation No.: 3511

Filed: July 10, 2003

Art Unit: 1742

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MONITORING THEREOF

Examiner: N. A. Smith

SUPPLEMENTAL APPEAL BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

As required under § 41.37(a), this brief is filed within three months of the Notice of Appeal filed in this case on August 23, 2007, and is in furtherance of said Notice of Appeal.

The fees required under § 41.20(b)(2) are dealt with in the accompanying
TRANSMITTAL OF APPEAL BRIEF.

This brief contains items under the following headings as required by 37 C.F.R. § 41.37 and M.P.E.P. § 1206:

- | | |
|------|---|
| I. | Real Party In Interest |
| II. | Related Appeals and Interferences |
| III. | Status of Claims |
| IV. | Status of Amendments |
| V. | Summary of Claimed Subject Matter |
| VI. | Grounds of Rejection to be Reviewed on Appeal |

VII.	Argument
VIII.	Claims
IX.	Evidence
X.	Related Proceedings
Appendix A	Claims

I. REAL PARTY IN INTEREST

The real parties in interest for this appeal are:

International Business Machines Corporation of Armonk, NY

II. RELATED APPEALS, INTERFERENCES, AND JUDICIAL PROCEEDINGS

To the best of Applicants' knowledge, there are no other appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

A. Total Number of Claims in Application

There are 11 claims pending in application.

B. Current Status of Claims

1. Claims canceled: 1-15
2. Claims withdrawn from consideration but not canceled: 0
3. Claims pending: 16-26
4. Claims allowed: 0
5. Claims rejected: 16-26

C. Claims On Appeal

The claims on appeal are claims 16-26.

IV. STATUS OF AMENDMENTS

An Amendment after a Non-Final Office Action was filed on September 12, 2006. The claims appealed herein are the claims of record entered after the Non-Final Office Action of July 13, 2006 and considered in the Final Office Action of November 15, 2006.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claimed subject matter relates to a method of operating a plating bath. The method involves providing a plating bath with at least an accelerator, plating at least a metal on a substrate, measuring the bath concentration of at least one accelerator breakdown product (void formation marker, VFM), measuring the bath concentration of the at least an accelerator and determining a VFM ratio at a plurality of time-points, counting, for each of the time points the number of voids in the metal plated on the substrate. Next a VFM threshold ratio as the highest VFM ratio at which no voids are observed in the metal plated on the substrate is determined and the VFM ratio is maintained below this VFM threshold ratio by performing a bleed and feed of the plating bath to maintain the VFM ratio below the threshold VFM ratio. The independent claim involved in the Appeal is discussed in paragraphs [0012] to [0017] on pages 4 and 5 of the specification, in paragraphs [0044] to [0049] on pages 12-14 of the specification and is illustrated in Figure 4 of the specification.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

- A. A rejection to be reviewed on Appeal is of claims 16-20 and 24 under 35 U.S.C. §103(a) over Seita et al. (U.S. Patent No. 6,881,319, Blancher et al. (U.S. Patent No. 6,569,307), Kopp (U.S. Patent No. 6,083,374) and Sun et al. (U.S. Publication No. 2002/0125142).
- B. A rejection to be reviewed on Appeal is of claim 21 under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp, Sun et al. and Skoog et al. (Fundamentals of Analytical Chemistry 7th Edition; Saunders College Publishing, Fort Worth, 1996, Pgs. 701-702 and 708-709).
- C. A rejection to be reviewed on Appeal is of claims 22 and 23 under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp, Sun et al., and Talasek et al. (U.S. Publication No. 2004/0108213).
- D. A rejection to be reviewed on Appeal is of claims 25 and 26 under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp, Sun et al.

VII. ARGUMENT

- A. Argument for claims 16-20 and 24 rejected under 35 U.S.C. §103(a) over Seita et al. (U.S. Patent No. 6,881,319, Blancher et al. (U.S. Patent No. 6,569,307), Kopp (U.S. Patent No. 6,083,374) and Sun et al. (U.S. Publication No. 2002/0125142).

The claimed method of operating a plating bath is not obvious over the cited references because the Office has failed to establish a *prima facie* case of obviousness. Specifically, the Office has failed to articulate a reason why one skilled in the art would combine and modify the cited references as suggested by the Office. The disclosure relates to a method of operating a plating bath such that the number of voids in the plated metal is minimized. The method involves first plating a metal on a substrate in a plating bath containing an accelerator. Then an accelerator breakdown product concentration and remaining accelerator concentration is measured along with the number of voids in the plated metal. This process is repeated and the

relative concentration of accelerator breakdown product to accelerator concentration (VFM ratio) is then determined as a function of the number of voids in the plated metal.

The plating bath is then operated at a VFM ratio below the highest VFM ratio (threshold VFM ratio) at which no voids are observed. The results of this process are illustrated in Fig. 4 of the specification where the number of voids as a function of the VFM ratio is plotted. The method provides for a convenient method of operating a plating bath while minimizing the number of metal voids. Applicants have found that the relative concentration of accelerator breakdown product to accelerator determines the number of metal voids in a plating process. This process provides for an improvement over traditional methods which seek to improve plating operations by controlling a single variable which is typically the concentration of starting materials or by-product contaminants in the plating bath. None of the cited references teach or suggest this relativistic approach to operating a plating bath.

Seita describes a method for controlling an electrolytic copper plating solution. The method involves addition of a thiol-reactive compound to the plating solution to maintain the decomposition products of a specific sulfur-containing compound which is added for the purpose of increasing the deposition rate in the vicinity of the bottom of a micro via whole (column 2, lines 15-56). The method includes maintaining a specific maximum allowable concentration for the decomposition product ($0.15 \mu\text{mol/L}$) and adding a thiol-reactive compound (1×10^{-4} to $1 \times 10^{-1} \text{ mol/L}$) to maintain the bath below the maximum allowable decomposition product concentration (column 5, lines 64-67 and column 7, lines 4-15). Overall, Seita only describes controlling the decomposition product to a maximum concentration using a chemical additive (a thiol-reactive compound).

The Office has stated that the determination of the maximum allowable concentration for the decomposition product corresponds to the “void formation marker, VFM” recited in claim 16. Applicants agree that the VFM is a measurement of at least one accelerator breakdown product and that Seita describes the measurement of the decomposition product of a specific sulfur-containing compound. However, the Office has not distinguished between a VFM value and the VFM ratio. The VFM ratio is the concentration of the VFM divided by the concentration

of the accelerator. The claimed method distinguishes over the references by use of the VFM ratio to control the plating bath operation.

As noted above, the determination of the VFM ratio and the use of this ratio to operate a plating bath is not taught or suggested by the cited references. Specifically, the Office has noted on page 3 of the May 24, 2007 Office Action that Scita and Blanchier describe monitoring only the breakdown concentration not both the breakdown concentration and the original concentration of the plating bath component. Sun et al. describes monitoring the original additives of the plating bath components. However, the combination of these references does not teach or suggest all the recitations of the claimed method (i.e. using the VFM ratio to control plating bath operation).

The Office has noted on page 4 of the May 24, 2007 Office Action (Item 12) that the VFM ratio is not taught or suggested by the cited references. However, the Office concludes that the determination of the claimed VFM value and the claimed measuring of the bath concentration of the at least an accelerator is taught by the combination of the references. The Office Action continues by stating that “[a] mathematic calculation (determining) is not a patentable designation and therefore the prior art inherently teaches such determination steps.” Applicants submit that this analysis misses the point that the calculated VFM ratio is used to control plating bath operation and this method step is not taught or suggested by the cited references. Applicants are not claiming a mathematical calculation, but the use of that calculated number in a useful method. Simply knowing the VFM number and the acceleration component concentration (C) does not teach or suggest using the ratio of these numbers to control a process. The relationship $VFM\ ratio = VFM/C$ may exist in the reference plating bath, but controlling the bath to a given VFM or a given C is not the same as controlling to a given VFM ratio. The cited references do not teach or suggest utilization of this relationship in a process and this distinction alone renders the claimed method non-obvious over the cited references. Applicants have found that this ratio provides a good control of plating bath operation. The cited references describe using a single value such as the concentration of the decomposition products to control plating bath operations not the ratio of two plating bath constituents.

The Office Action also notes that the combination of Seita, Blanchier and, Kopp and Sun describe maintaining the breakdown products concentration below a fixed VFM concentration and the concentration of substances in a plating bath at a given value. Applicants note that the claimed method does not require this VFM and the accelerator concentration to be individually fixed or at a given value. The VFM ratio is a relative number that does not require these two concentrations to individually be set. The two concentrations may vary individually with the ratio of these two values (VFM ratio) being used to control operations. Again, this is a distinction of the claimed method over the combination of the cited references. Accordingly, the claimed method would not have been obvious over the combination of these cited references.

In addition, Applicants are unsure as to how the Office is proposing to modify Seita. As noted above, Seita requires adding a thiol-reactive compound to neutralize a deleterious decomposition product of a sulfur-containing compound. Elimination of this required step would render the described method in Seita unsuitable for its intended purpose. Why would one skilled in the art be motivated to eliminate this required step? If this required step were maintained, Applicants are unsure as to how the proposed method would operate. Would there be an expectation of success in combining the method in Seita with the other cited methods? How would such a process successfully operate? Since the proposed modification would either render Seita unsuitable for its intended purpose or give a process with an unknown expectation of success, the claimed process would not be obvious over Seita in combination with Blanchier, Kopp and Sun.

The Office notes that Blachier et al. like Seita et al. describes monitoring breakdown products in the plating bath and controlling the plating operation by use of the breakdown products. The Office also notes that Sun et al. describes monitoring additive levels in the operation of a plating bath. (See pages 3 and 4 of the January 18, 2007 Office Action). The Office then concludes it would be obvious to take the ratio of the breakdown product concentration (Seita et al.) and the product concentration (Sun et al.) to operate a plating bath operation. This analysis requires not only combining references but modifying the combination of the references. However, the Office has articulated no reason why one skilled in the art would be motivated to make this modification.

To reach this conclusion there must be some predictability in the art that such a combination and modification would be successful (KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. (2007)), Takeda Chemical Industries Ltd. v. Alphrapharm Pty. Ltd. 83 USPQ 2d (Fed. Cir. June 28, 2007) and ex parte Smith, USPTO Appeal 2007-1925, decided June 25, 2007). Applicants submit that such a modification was not predicable at the time the invention was made, and therefore, claims 16-20 and 24 would not have been obvious over the cited references.

- B. Argument for claim 21 rejected under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp, Sun et al. and Skoog et al. (Fundamentals of Analytical Chemistry 7th Edition; Saunders College Publishing, Fort Worth, 1996, Pgs. 701-702 and 708-709).

The arguments above regarding Seita et al. and Blancher et al., Kopp and Sun et al. are incorporated herein. Applicants submit that Skoog et al. does not make up for the deficiencies of Seita et al., Blancher et al., Kopp and Sun et al. discussed above. Accordingly, claim 21 would not have been rendered unpatentable under 35 U.S.C. §103(a) over the combination of these cited references.

- C. Argument for claims 22 and 23 rejected under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp, Sun et al., and Talasek et al. (U.S. Publication No. 2004/0108213).

The arguments above regarding Seita et al., Blancher et al., Kopp and Sun et al. are incorporated herein. Applicants submit that Talasek et al. does not make up for the deficiencies of Seita et al., Blancher et al., Kopp and Sun et al. discussed above. Accordingly, claim 21 would not have been rendered unpatentable under 35 U.S.C. §103(a) over the combination of these cited references.

- D. Argument for claims 25 and 26 rejected under 35 U.S.C. §103(a) over Seita et al., Blancher et al., Kopp and Sun et al.

The arguments above regarding Seita et al., Blancher et al., Kopp and Sun et al. are incorporated herein. Based on the arguments above, Applicants submit that claims 25 and 26 would not have been obvious over 35 U.S.C. §103(a) over the combination of these references.

Accordingly, in view of the above remarks and reasons explaining and reasons explaining the patentable distinctness of the presently appealed claims over the prior art, Applicants request that the Examiner's rejections be reversed.

VIII. CLAIMS

A copy of the claims involved in the present appeal is attached hereto as Appendix A. As indicated above, the claims in Appendix A do include the amendments filed by Applicant on September 12, 2007.

IX. EVIDENCE

No evidence pursuant to §§ 1.130, 1.131, or 1.132 or entered by or relied upon by the examiner is being submitted.

X. RELATED PROCEEDINGS

None.

Dated: November 19, 2007

Respectfully submitted,

Electron Signature:/Donald K. Drummond,
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APPENDIX A

Claims Involved in the Appeal of Application Serial No. 10/615,794

16. (Previously Presented) A method of operating a plating bath comprising:
- providing a plating bath containing at least an accelerator;
 - plating at least one metal on a substrate;
 - measuring the bath concentration of at least one accelerator breakdown product ("void-formation marker, VFM");
 - measuring the bath concentration of said at least an accelerator;
 - determining a VFM ratio at each of a plurality of time-points,
 - wherein said VFM ratio is the concentration of said VFM divided by the concentration of said accelerator;
 - counting, for each of said time-points, the number of voids in the metal plated on said substrate;
 - determining a VFM threshold ratio as the highest VFM ratio at which no voids are observed; and
- maintaining said VFM ratio below said VFM threshold ratio by performing a bleed and feed of said plating bath to maintain said VFM ratio below said threshold VFM ratio.
17. (Previously Presented) The method of operating a plating bath, according to claim 16, wherein determining a concentration of said VFM comprises:
- separating said VFM from said plating bath liquor; and
 - quantifying said VFM.
18. (Previously Presented) The method of operating a plating bath, according to claim 17, wherein said VFM is separated chromatographically.
19. (Previously Presented) The method of operating a plating bath, according to claim 18, wherein said VFM is separated by liquid chromatography.

20. (Previously Presented) The method of operating a plating bath, according to claim 18, wherein said VFM is separated by high performance liquid chromatography (HPLC).

21. (Previously Presented) The method of operating a plating bath, according to claim 18, wherein said chromatography comprises ion-pairing, reversed-phase chromatography.

22. (Previously Presented) The method of operating a plating bath, according to claim 17, wherein said quantifying is performed by instrumental analytical methods selected from the group consisting of spectroscopy and electrochemical detection.

23. (Previously Presented) The method of operating a plating bath, according to claim 22, wherein said spectroscopy comprises techniques selected from the group consisting of ultraviolet, visible, infrared, and mass spectroscopy.

24. (Previously Presented) The method of operating a plating bath, according to claim 17, wherein said quantitation is provided by instrumentation that provides a quantitative output in proportion to a concentration of said VFM.

25. (Previously Presented) The method of operating a plating bath, according to claim 16, wherein said bleed and feed comprises adding a volume of fresh bath liquor to bring the volume above a nominal bath volume and removing said fractional volume.

26. (Previously Presented) The method of operating a plating bath, according to claim 16, wherein said fractional volume is from about 1% to about 10%.

Appendix B

EVIDENCE

NONE

Appendix C

RELATED PROCEEDINGS

NONE